XXVI.—*Results of a Study of Bird-Migration by the Marking Method.*

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Contents.

I.—INTRODUCTION.

The Aberdeen University Bird-Migration Inquiry.

This paper embodies the main results of the Aberdeen University Bird-Migration Inquiry, which was set on foot in 1909 for the purpose of exploiting the method of study

afforded by the device of "bird-marking" and came to a gradual end during the war. Two interim reports have already been published: the first (19)* gave full details of all results obtained up to the summer of 1912, without any attempt to draw conclusions therefrom, and it may be of value as giving a fair sample of the kind of data obtainable by this method, although publication of the remaining results in such bulky form has been considered unnecessary. The second report (20) gave only brief notes on such further records, up to the spring of 1915, as were of particular interest. The writer has also read papers before the Royal Physical Society of Edinburgh (18) and the Zoology Section of the British Association for the Advancement of Science (1912 Meeting), setting forth the general scope and purposes of the method: in these and some minor papers a few early records were quoted, but they were also included in the first report. The purpose now in view is to summarise all the data in systematic form, and to give such conclusions as seem warranted either as to the value of the method or as to the facts and problems of bird-migration itself.

The writer carried on the inquiry as a piece of research from the Natural History Department of the University of Aberdeen, under the general direction of Prof. J. Arthur Thomson, LL.D. From 1910 to 1914, inclusively, most of the working expenses were covered by a grant from the Carnegie Trustees. A debt of gratitude is due also to those who co-operated in the actual marking of birds, as well as to the many correspondents who kindly supplied information as to "reappearances." The help in the central routine work of the inquiry rendered at different times by the late Mr. Lewis N. G. Ramsay, M.A., B.Sc., by Mr. James Ewing, M.A., D.Sc., and by Miss Maribel Thomson, M.A., B.Sc., calls for special mention; the last-named took the writer's place, as regards this work, throughout the war.

It should be stated that the work of marking was at its

* The numbers in parenthesis refer to the references given in Section XIII. (p. 526). References not relating to the marking method are quoted in the text.

height in 1914, and that it would have continued at a high level for a few years if circumstances had remained normal. As it was, the work not only entered on a premature decline, but a great deal of it was probably rendered less fruitful by unfavourable conditions for the reporting of reappearances.

The Purposes of Bird-Marking.

In its essentials the method consists of the marking of a large number of birds, in some way or other, for the sake of the data afforded by the subsequent reappearance of a small proportion of them. The principle is identical with that of the well-known method of marking fishes as a means of studying their movements and life-histories, while an analogous system has also been utilised in the study of ocean currents.

The method differs from other methods of studying migration in that it approaches the problems from the individual aspect—it begins with individual birds and works from them towards general movements. A marking record implies that there are two or more times in the life of a particular bird when one is able to state with certainty its whereabouts and various other facts, these times being usually those of infancy and of death. When a large number of these records has been collected and correlated, there will exist an array of facts which could not have been ascertained by other means.

To estimate the value of information of this kind, the nature of the problems must first be considered. Perhaps the greatest and most difficult problem of migration is that of its origin—its ultimate cause. To an appreciable extent the purpose served by migration, its *raison d'être*, is known, and the immediate factors which periodically stimulate the migrational habit into being may be surmised : but the question of the origin of the habit still lies completely within the realm of conflicting theory. A matter of theory and hypothesis it must doubtless ever remain, but one may at least put the theories to the test of facts and eliminate those that are found wanting. One thing seems obvious, and that is

that migration is a far too complex and also a far too regular phenomenon to be created anew each season merely under stress of circumstances ; moreover, it is known that migration begins before the need is in the least pressing. The more or less indefinite wanderings of some sea-fowl, the irregular dispersals of some other birds, and the late "weather movements" that occur in severe seasons may be attributed to immediate causes, but a deeper seated origin—not necessarily identical for every species—there must surely be, for the highly developed habit of some of our more typical migrants.

A little consideration will show how speculation regarding this origin is rendered futile for lack of a certain kind of fact. For instance, there is the perhaps rather far-fetched theory that the migrational habit was established by some great meteorological change in the distant past—say by a Glacial Epoch, as has been suggested, which drove the birds resident in northern latitudes towards the Equator, and made them form there a second home : to this they would annually return, it is supposed, after the cessation of the unfavourable conditions had allowed them to re-colonise their original more northerly area as a summer home, the individuals continuing to use the routes followed by the species at the time of the first great movement. Then there is the more recent theory (*cf.* Pycraft, History of Birds, 1910, p. 100) that the migrational habit arose from the gradual northward spread of a species from a supposed original southern area in search of fresh feeding and breeding grounds, the birds withdrawing to this original area each winter. Without discussing these theories, it may be noted how their proof or disproof would necessarily rest on a knowledge of the facts concerning the relation of particular summer-quarters to the corresponding winter-quarters, and of the routes connecting them. Thus it is often suggested that the members of a species summering farthest north winter farthest south, and that those midway are more or less stationary (*cf.* Swallow, Section X.) ; but the observer only sees a general southward movement, and typical individuals must be singled out for study before

the question can be answered. Again, there are many cases of species which are found all the year round in the British Isles, but yet are known in autumn both as immigrants from the north and as emigrants to the south, and *vice versa* in spring. Now, except by marking one can hardly hope to be sure whether it is our own summer birds that emigrate, leaving the newcomers to occupy the area for the winter, or whether our own birds are resident while the immigrants pass on over their heads and journey farther southwards. And until this is known, very little of the true nature of migration can be understood.

Some of the questions which may be answered in due course by the marking method are as follows, and most of them have an important bearing on one or other unsolved problem of bird-migration :—To what extent do birds return to their birthplaces to breed, and under what circumstances are new areas colonised? Do birds have definite winter-quarters, and if so, do they seek them year after year? Do young birds seek the same winter-quarters as their parents? Do birds of the same summer area (and same species) seek the same winter area? What relation do the winter-quarters of the northerly-breeding members of a species bear to those of the southerly-breeding members? Do migrants travel by different routes, and if so, what is the nature of these routes? And these questions by no means exhaust the subject.

While urging the value of bird-marking, one must remember that it is only supplementary to other methods, and must not be practised to their exclusion. In passing, too, it may be noticed that bird-marking may incidentally serve other ends than those connected with migration. There are various kindred points relating to distribution for instance, and interesting evidence of the rate of mortality is occasionally afforded. Furthermore, it might be a valuable aid to the study of plumage sequences to acquire a collection of birds which had lived entirely free and natural lives and of which the ages were accurately known.

Historical Survey of Bird-Marking.

Various kinds of marks have been tried or suggested, such as parchment tied under the tail with silk, thin metal discs glued to the tail-feathers, and indelible stamps on the tail-feathers. But all these, besides being clumsy, have the great disadvantage of lasting only until the next moult, and for both convenience and permanence marks on the feet are obviously the best. In early, isolated attempts at marking, such crude means as brass wire or silk thread twisted round the bird's foot were used; but in order to allow of an inscription, a broad metal ring is necessary. As combining extreme lightness with a moderate degree of durability, aluminium is to be preferred, and all the more because it is easily worked and stamped.

Complete rings, such as are used for homing-pigeons, are of little use for marking wild birds, as they can only be placed on very young birds in any case, and not even then in the case of birds with nidifugous young, these having well-grown feet by the time they are hatched. Furthermore, these rings are expensive, as they are cut from aluminium tubing instead of from sheet aluminium, and have to be stamped when in circular shape instead of on the flat. Hence the superiority in every way of the "split ring," which is a band stamped from a sheet and then folded into a circle. The edges are merely pressed together, and a ring of this kind, if of small diameter, will keep its shape without difficulty. Rings of larger size must either be of thicker metal to do this, or must have a clasp of some kind. A very simple pattern is one in which the band is longer, and is not all used in forming the circle; two unequal ends are left to project outwards side by side at the meeting place, the longer being afterwards folded over the shorter, and so forming a clasp which, especially if subjected to pressure with a pair of pliers, will effectually prevent the ring from coming off. It may be mentioned that for Moorhens, Divers, and some other water-birds, the rings require to be bent into oval shape to fit the much compressed tarso-metatarsus.

Birds may be procured for marking in two ways. Either they may be marked as young birds still unable to fly, or they may, when older, be trapped by any non-hurtful means and then marked and released. Notification of their subsequent death or re-capture depends on the address which is stamped on the ring. Some markers have been content with mere initials, but this is very wasteful as it is obvious that it must greatly reduce the number of recorded reappearances and practically exclude the possibility of records from any great distance. Many rings with various insufficient addresses have, indeed, been found on birds but never traced to their origin although widely advertised in ornithological periodicals : and there is, in any event, no great difficulty in stamping a short address even on the smallest ring. In addition to the address each ring should bear its own identification number, which is indeed the key to the whole method. Some markers have used year marks (the year in figures, or some arbitrary sign), but this is only possible where the marking is confined to a single locality and to a single species, and if the birds are all marked when young. Thus, if the rings bearing a certain address are being used solely for young Woodcock on a single estate, a year mark is sufficient ; but where the histories of the birds marked differ from each other, separate identification is necessary. Species is not a reliable factor for this purpose, in that marked birds are often reported by persons quite ignorant on the subject, and it is thus essential that the number on the ring should be all that the marker requires in order to determine the species and history of any marked bird of his that is reported.

The rings soon lose their brightness, especially in the case of water-birds, and are not usually visible on the birds except with strong field-glasses and under favourable conditions. Marking is thus in no way an encouragement to the slaughter of our wild birds : the proportion of ringed individuals to the whole bird population will always remain so small that any shooting of birds for the sake of chance ringed specimens would be ridiculous. It is also worthy of note that many

marked birds are reported as found dead or wounded, or as captured and subsequently released.

The question as to whether the rings have a harmful or disturbing effect on the birds has also been raised. It must be remembered, however, that the ring rests lightly on the insensitive scales of the foot, and is insignificant in weight compared with the size of the bird; the writer's smallest ring, suitable for Sparrows, weighed only about 1/6th of a gramme, and his largest, for Herons, only about 1 gramme (average). A newly marked bird pays little or no attention to the ring, and out of a large number of ringed feet returned to the writer for examination only two or three showed any signs of injury, due in these cases to the use of a wrong size of ring by the marker. The migrational habit might presumably be interfered with in cases where a large mass of weeds or other matter became firmly entangled with the ring—no case of this kind has been reported,—but undue stress can, in any event, never be laid on any isolated record.

The device of marking birds in some way was not infrequently resorted to, in isolated cases and for special purposes, by naturalists of earlier days, and one often comes across stray records. But, so far as the writer is aware, it was not until 1890 that the first systematic scheme was set on foot. In that and many subsequent summers, numbers of young Woodcock were marked on the Duke of Northumberland's estate at Alnwick (14). The rings were inscribed with an "N," and the date (year).

In 1899, Mr. H. Chr. C. Mortensen, of Viborg, Denmark (9, 10, 11, 12, 13), started a more ambitious inquiry, and the Stork, the Heron, the Teal, and the Starling are among the species which he has studied by this method. Mr. Mortensen may, indeed, be regarded as the pioneer of scientific bird-marking, because his inquiry was the first which was thoroughly comprehensive in scope and exact in methods: the use of identification numbers instead of mere year figures was a good innovation which opened up many fresh possibilities, although at the same time involving much more labour in the way of record-keeping.

In 1903, Dr. J. Thienemann (16, 17), Director of the German Ornithological Society's station at Rossitten on the Baltic coast, started an important inquiry. The results obtained in the cases of the Stork and the Hooded Crow, especially, are of great interest. More recently the work has been extended to Heligoland (24, 25).

In 1908, the method was adopted by the Hungarian (State) Ornithological Central Bureau (8, 15). Similar schemes have also been set on foot in Holland (23), and in other parts of the Continent.

Also in 1908, the method was taken up in the United States (1, 4, 5), where, however, it was not previously altogether unknown (2, 3), and in the following year an "American Bird Banding Association" was constituted. The rings issued by the Association bore the inscription "Notify *The Auk*, New York" and a number. More recently the work has been taken over by the Biological Survey of the Department of Agriculture at Washington.

Meanwhile some progress had been made in this country. Several years ago Mr. Richard Tomlinson (22) began marking Starlings at Musselburgh, near Edinburgh. In 1904, Mr. J. H. Gurney marked a number of young Gannets on the Bass Rock (Firth of Forth) with rings inscribed "Bass Rock, 1904." In 1905, Mr. John Hamilton (7) of Baron's Court, Co. Tyrone, Ireland, began marking Woodcock with rings inscribed with "B. C." and the year in figures. Between 1910 and 1916 over 300 Woodcock were marked on Colonel W. W. Ashley's estate in County Sligo, as reported by Captain S. R. Douglas (6). Other proprietors have also marked Woodcock, for instance Lord Ardilaun at Cong, Galway, using rings inscribed "A. Cong," while Sir Richard Graham has used rings inscribed "R. G." for various species of Duck (for the most part hand-reared) marked at Netherby, Cumberland. In 1908, Dr. C. B. Ticehurst (21), following Mr. Mortensen's methods, started marking various birds in the south of England with rings inscribed "Ticehurst, Tenterden." Various other inquiries on a smaller scale have been set on foot at different times.

In 1909, the first efforts were made at bird-marking on a large scale in the British Isles, two inquiries being started independently and almost simultaneously, namely the Aberdeen University Inquiry, now under review, and Mr. H. F. Witherby's scheme (26) in connection with the magazine "British Birds." Of these, the latter is still in progress and close on a hundred thousand birds have been marked: the eventual publication of the collected and analysed results will be an event of great importance to students of migration. It may also be noted that some of the earlier markers merged their work with the new schemes, as Mr. Tomlinson did his with the Aberdeen University Inquiry, and Dr. Ticehurst his with the "British Birds" scheme, the work being profitable only if undertaken on a very large scale.

Methods of the Aberdeen University Inquiry.

Each ring bore the address "Aberdeen University" (contracted to "Aberdeen Univ." on the smallest size), and an identification number. A plain number, sometimes written in two lines, was used where possible, but on the smallest size the need for brevity led to the use of such numbers as "0798," and letter combinations like "299A." After the first experimental stage the rings were made in the following seven sizes, named in fractions of an inch, the first four for ordinary use and the three largest for those markers who had special facilities for ringing sea-fowl and other large birds. The first three sizes were of the claspless pattern, while the other rings were provided with the form of clasp already described, and had also edges turned outwards as flanges.

1/8th—Finches, Swallows, Titmice, Redbreast, Lark, Sandpipers, Little Tern, etc.
3/16ths—Thrushes, Starling, Lapwing, Snipe, etc.
1/4th—Woodcock, Jackdaw, Black-headed Gull, Kestrel, Teal, Stock-Dove, etc.
5/16ths—Rook, Crows, Owls, Wood-Pigeon, Guillemot, Wigeon, etc.
3/8ths—Herring-Gull, Mallard, etc.
1/2—Gannet, etc.
5/8—Heron.

(*All these rings were made by Mr. Samuel Drake, Halifax.*)

The numbers, sizes, and destinations of all rings issued to markers were carefully noted and reappearances of marked birds were checked by these notes. Along with the rings were sent schedules on which the data about all birds marked were to be filled in, the following information being asked for:—(1) Number on ring; (2) Species of bird; (3) Date of marking and release; (4) Locality of marking and release; (5) How obtained ("as young," etc.); (6) Sex and age so far as certain; and any other remarks, including bracketing together members of the same brood with word to that effect. When the completed schedules were returned, the data were transcribed into ledgers, in which the entries were arranged serially according to the ring numbers, a final column being left blank for the purpose of entering references to the "Case numbers" in the separate card-index of re-appearance records.

When a marked bird was reported as killed or recaptured, the number on the ring was the chief thing required, together with a note of the locality and approximate date of the occurrence. If the ring, with or without the foot, were sent, or if the species were identified, an additional check on the accuracy of the record was provided. Many birds were naturally recorded from the places where they were marked, and the interest of these records depended on the lapse of time and on the other circumstances of the case: cognisance was taken of all records of this kind, however, except when a bird was recorded on the same day, or, in the case of young birds, within the flightless period.

At the outset of the investigation no restriction was made as to the species of birds which were to be marked, and each co-operator was left to make use of whatever opportunities he might have. These opportunities were for the most part confined to young birds as yet unable to fly, but large numbers of birds were also caught in nets set up for the purpose and a few were caught at lighthouse-lanterns or at night on the sea-shore. It was felt that the widest possible scope would provide the fairest test of the value of the

method, and even in the case of purely resident species the extent of local movements was considered worthy of study. Earlier schemes, perhaps more by chance than by intention, had been confined for the most part to a limited number of especially interesting species which had well repaid the labour and cost of marking: no guide, therefore, existed as to the possibilities of a more comprehensive plan of campaign.

It soon became evident, nevertheless, that in many directions the results were very meagre as compared with the number of birds being marked. The scope of the Inquiry was accordingly limited to a few species, selected for a variety of reasons. Three qualities were thought necessary for a species to be classed as a good subject: the birds had to be procurable for marking in large numbers, they had to afford a good percentage of reappearance records, and their migratory movements had to be of interest. Some of the best subjects under the first and second of these headings, such as certain gulls and game-birds, were unfortunately lacking in the third quality, while most of the small passerine birds showed an extraordinarily low percentage of reappearance records apart from cases where they were re-caught by the marker. The species finally selected were the Lapwing, the Starling, the Song-Thrush, the Blackbird, the Woodcock, the Mallard, and the Herring-Gull. To these were added the Redbreast and the Swallow, chiefly because a large stock of the appropriate size of ring remained, and also the Lesser Black-backed Gull in the expectation, never realised, that a large number could be marked. Had the work continued, the tendency would have been to concentrate more and more on the Lapwing and the Starling.

The Interpretation of Results.

In the following sections a few species which have afforded interesting and comparatively numerous records are discussed separately and at length. The method adopted in each case has been based on a system of grouping in

accordance with the districts in which the birds were marked, as is explained more fully in Section II. : a distinction has also been maintained between birds marked when young and birds obtained under other circumstances, the latter class being further sub-divided under seasonal headings. The object in view has been to keep together records relating to birds originally belonging to presumably homogeneous groups, and in this way to eliminate errors due to possible geographical differences. But where the grouping has revealed no marked divergency, the separate treatment of the groups is abandoned.

The data thus grouped have been analysed, as a rule, in three different ways. The principal analysis is a seasonal one, the reappearance records of all birds of a particular group, or series of similar groups, being classified according to locality and calendar month. In this main analysis the records of birds recovered in their first, second or subsequent seasons, are treated alike : to exclude any error from this source a second analysis is added in which the classification is by localities and ages. The third analysis is similar to the second, but is based on the calendar year (reckoned from summer to summer) instead of on the year of the bird's life, and it thus affords a check on possible errors due to meteorological differences between one winter and another. The fulness with which the grouping and analyses have been published will be found to vary with the circumstances.

A further section of the report contains a series of brief summaries of the records relating to those species for which the data are insufficient to warrant any more elaborate treatment. Many of these summaries, however, contain more or less isolated records which are of some interest despite the danger that lies in too much importance being attached to occurrences which may possibly be exceptional. The possibility of entirely exceptional individual movements being recorded by the marking method is indeed a point which must constantly be borne in mind by students of the

subject, and isolated records must always be regarded with suspicion and as at best suggesting the theoretical explanations which they seem to indicate. The chances of a faulty record are in themselves almost negligible if the method is carefully and scrupulously followed: wrong ring numbers have frequently been reported and have been speedily detected by being inconsistent with the particulars of marking of the bird to which the number really belonged. There are, however, several records which suggest that the individual birds concerned behaved in an abnormal manner (*cf.* Mallard, Section VI.), and this makes it the more necessary that all deductions should rest on a broad foundation.

It would obviously be desirable to collect a mass of data sufficiently large to be treated statistically, but it cannot be said, in view of the numerous unknown factors, that this has yet been achieved. In the first place there is to be considered the possibility that the material being dealt with is not wholly homogeneous: even in the case of birds of the same species bred in the same area there may be migratory and resident individuals, and therefore possibly migratory and resident races. In the case of birds caught and marked in winter the material is more obviously of mixed origin and may even contain morphologically distinguishable geographical races or subspecies. Not only may some individuals of a species be migratory while others in the same area are resident, but there is no ground for assuming that all the migratory individuals perform similar movements: the movements, indeed, certainly differ in degree and may differ in kind, and it is not even fair to assume that the same individual will act in an identical manner in successive years. It follows, also, that great caution is necessary in deducing routes of migration from records relating to different birds. The obvious temptation is to plot on a map all the localities of reappearance and to consider them as points in a common path, but it is not sound reasoning to say, for instance, that because many

records for a given species come from Ireland and others from Portugal the former country must lie in the route of the birds which travel to the latter.

The most important unknown factor, from a statistical point of view, is the actual mortality rate and its geographical and seasonal incidence. The student of the method, unfortunately, deals only with what may be called the "recorded mortality," and he can only attempt to guess what fraction of the whole it represents. Furthermore, the proportion between true and recorded mortality must vary in different circumstances according to the chances that exist of a dead bird being reported. It may be safely assumed, for instance, that a smaller proportion of actual deaths is reported from foreign countries than from the British Isles, while the fact that birds tend to meet death in different forms at different times of year, especially in the case of species shot for sport, may materially influence the matter. Even were it possible to estimate the true mortality, this would not afford a perfect index of the comparative total numbers of birds present in particular areas at particular times.

The foregoing considerations apply mainly to records which show actual movements, for it is true that in these cases a record usually originates through the death of the bird. But a similar and even more uncertain factor exists in the cases of more or less sedentary birds which are re-caught, often many times, at the places where they were marked. Records of this latter kind depend largely on the activity of the marker himself, who continues to trap birds for further marking and in the process constantly recovers birds he had previously released. Not only may the marker's efforts be erratic for personal reasons, but he will be largely governed by the greater facility with which birds are caught at some seasons as compared with others. An uncertain factor is therefore introduced into the marker's own records of birds recovered, while a much greater one must be allowed for if these records are compared with those

from other sources where special opportunities for obtaining records do not enter into the question.

In the sections which follow the comparisons made with the results of other investigators are by no means exhaustive. The species successfully studied abroad are for the most part unimportant in this country, so far as records go, and the results of the 'British Birds' inquiry (26), which are the most important for this purpose, have as yet been published in collected form only in the case of a very few species.

The Numbers of Birds marked during the Aberdeen University Inquiry.

Table I. shows the total numbers of birds of different species marked during the course of the investigation. In the third column the number of reappearance records is given, and in the fourth column the percentage of marked birds which have reappeared. The figures may be regarded as complete for all practical purposes, as additional records have, at the time of writing, become very infrequent. From the numbers and percentages of reappearance records the following are excluded :—

(*a*) Records of birds recovered at the same place on the day of marking, or, in the case of young birds, within the flightless period;

(*b*) Incomplete and faulty records which have not been considered sufficiently well established to be included among the results ;

(*c*) Second and subsequent records for the same bird.

The percentage is not calculated for species of which less than fifty individuals were marked, and it should be accepted with reserve in cases where the total is less than some hundreds.

Detailed summaries of the numbers marked are given in the case of certain of the more important species discussed at length in the subsequent pages.

TABLE I.

Numbers of Birds Marked and Recovered.

Species.	Total numbers marked.	Total numbers of Reappearance Records.	Percentage of Reappearance Records.
Song-Thrush	3,770	52	1·4
Lapwing	3,142	63	2·0
Blackbird	2,641	68	2·6
Starling	1,900	62	3·3
Common Tern	1,352	6	0·4
Redbreast	1,206	61	5·1*
Swallow	1,198	5	0·4
Black-headed Gull	1,150	27	2·3
House-Sparrow	1,041	71	6·8*
Greenfinch	1,021	45	4·4*
Hedge-Sparrow	898	66	7·3*
Chaffinch	811	17	2·1
Blue Titmouse	653	70	10·7*
Willow-Warbler	501	1	0·2
Herring-Gull	461	25	5·4
Mallard	425	95	22·4*
Wren	274	2	0·7
Red Grouse	265	11	4·2
Partridge	256	15	5·9
Mistle-Thrush	230	1	0·4
Sky-Lark	228	0	0·0
Pied Wagtail	217	0	0·0
Spotted Flycatcher	203	2	1·0
Yellowhammer	193	2	1·0
House-Martin	183	0	0·0
Linnet	176	0	0·0
Great Titmouse	172	32	18·6*
Woodcock	156	21	13·5
Meadow-Pipit	150	1	0·7
Wheatear	146	0	0·0
Wood-Pigeon	132	12	9·1
Whitethroat	130	0	0·0
Common Gull	102	3	2·9
Sand-Martin	92	0	0·0
Moorhen	88	2	2·3
Ringed Plover	85	1	1·2
Grey Wagtail	84	0	0·0
Oystercatcher	79	4	5·1

* In the species marked thus the proportion of recoveries must be regarded as abnormally "inflated" owing to special activities on the part of the markers: the remark applies to a lesser extent in certain other cases.

Table I. (*continued*).

Species.	Total numbers marked.	Total numbers of Reappearance Records.	Percentage of Reappearance Records.
Redshank	68	0	0·0
Coal-Titmouse	65	1	1·5
Corncrake	65	2	3·1
Goldcrest	61	0	0·0
Rook	54	0	0·0
Common Sandpiper	51	0	0·0
Dipper	50	0	0·0
Curlew	49	2	—
Pheasant	49	3	—
Swift	49	1	—
Chiffchaff	49	0	—
Little Tern	48	1	—
Lesser Black-backed Gull	44	0	—
Bullfinch	42	1	—
Jackdaw	41	3	—
Puffin	40	0	—
Kittiwake	39	0	—
Heron	39	3	—
Redstart	38	0	—
Nuthatch	37	0	—
Sedge-Warbler	35	0	—
Snipe	34	1	—
Sheld-Duck	31	3	—
Garden-Warbler	31	0	—
Cormorant	30	1	—
Reed-Bunting	30	0	—
Teal	28	2	—
Guillemot	22	1	—
Cuckoo	18	1	—
Redwing	14	1	—
Dunlin	13	1	—
Coot	13	1	—
Golden Plover	12	1	—
Wigeon	8	2	—
Barn-Owl	7	2	—
Goldfinch	5	1	—
Long-eared Owl	2	1	—
Miscellaneous (species of which less than 30 were marked and none was recovered)	680	0	—
Total	27,802	879	3·2

II.—THE LAPWING (*Vanellus vanellus* Linn.): ANALYSIS OF RECORDS.

Although found all the year round in the British Isles, except in some inland districts, this species is well-known as a migrant. The migrations which may be observed are indeed extremely complex, and they have already been very fully worked out from the point of view of mass movements (*cf.* Eagle Clarke, Report Brit. Assoc. for 1902, p. 277). In addition to autumn movements within the country, there are at that season both immigrations from the north and east and emigration to the south. If very severe weather occurs during the winter there may be a resumption of these movements, even if so late that the normal date for the spring migrations in the opposite direction is close at hand.

The case is typical of a great part of the general phenomena of migration in the British area, and the obstacle which stands in the way of a full understanding of what takes place is the difficulty of ascertaining the respective parts played by the native birds and by the winter visitors and birds of passage from the Continent: to what extent, one asks, do the former remain sedentary while the latter journey on to form the southward stream? And it has already been argued that it is questions of this kind which probe the very nature of the migratory habit.

Fortunately the species has proved a very suitable one for study by the marking method, and the results already obtained show how the data from other sources may be supplemented in important respects. The writer would indeed urge the value of a concentrated investigation of this species, on a larger scale than has yet been tried, as being likely to yield results of very great theoretical interest.

Table II. gives the numbers of Lapwings marked during the course of the inquiry, and the numbers recovered in the respective categories. For the purpose of grouping, the following arbitrary geographical regions have been defined :—

North of Scotland: From Inverness-shire, Nairn, and Moray (inclusive) northwards.

North-East of Scotland: Aberdeenshire, Banffshire, and Kincardineshire.

Central Scotland: The remainder, as far south as the Firths of Forth and Clyde.

South-East of Scotland: Eastern side, south of the Firth of Forth.

South-West of Scotland: Western side, south of the Firth of Clyde.

North of England: From Yorkshire and Lancashire (inclusive) northwards.

South of England: The rest of England and Wales, but, in effect, almost entirely the southern counties.

Ireland.

TABLE II.

Numbers of Lapwings Marked and Recovered.

Seasons of marking as chicks.	Numbers marked (by regions).									Numbers recovered (by seasons of marking).
	N. Scotland.	N.E. Scotland.	C. Scotland.	S.E. Scotland.	S.W. Scotland.	N. England.	S. England.	Ireland.	Total.	
1909.....	—	24	1	—	—	—	—	—	25	1
1910.....	17	232	23	2	25	—	—	—	299	10
1911.....	14	379	11	7	1	8	26	—	446	6
1912.....	43	386	38	12	15	88	29	3	614	13
1913.....	157	335	58	29	10	25	1	8	623	19
1914.....	48	395	46	16	3	11	—	31	550	9
1915.....	—	210	—	5	12	12	—	—	239	2
1916.....	—	114	71	27	13	3	7	—	235	1
1917.....	—	65	—	1	17	—	—	—	83	2
1918.....	—	8	—	—	—	—	—	—	8	—
1919.....	—	9	—	—	4	—	—	—	13	—
Not as chicks ...	—	4	1	1	—	1	—	—	7	—
Total ...	279	2161	249	100	100	148	63	42	3,142	63
Numbers recovered (by 'regions' of marking).	3	42	7	—	6	3	2	—	63	2·0%

The percentage of marked Lapwings recovered is thus approximately 2·0, if calculated on the total. But when calculated for separate years the figures vary from 0·4 to 3·3 per cent. if all years in which over 200 were marked be taken, and from 1·3 to 3·0 per cent. if limited to those years in which over 400 were marked. Similarly, the percentage varies from 1·0 to 2·8 when calculated separately for the regions in which over 200 were marked, and is 1·9 in the case of the single region in which the number was much larger. In making comparisons between the numbers of records falling under particular headings, therefore, it would be unsafe to attach significance to any figure which could not be assumed to represent a total of several hundred marked birds. Numerical contrasts are accordingly permissible only between the widest categories, and analysis must be for the most part qualitative rather than quantitative.

As this species is of especial interest, and as it is the first to be discussed here, the records and the various forms of analysis are given in full. Table III. is a complete list of all the reappearances, grouped in the manner already explained.

TABLE III.

List of Reappearances of Marked Lapwings.

Season of marking.	Case No.	Date of Reappearance.	Locality of Reappearance.
Marked as chicks in the North of Scotland.			
1912.....	410	20. 8.14	Place of marking.
1913...	403	ca. 22.11.13	Co. West Meath, Ireland.
	899	early 1.14	nr. Oporto, Portugal.

Table III. (*continued*).

Marked as chicks in the north-east of Scotland.

1909	1	13. 6.09	Place of marking.
1910 ...	60	15. 7.10	Place of marking.
	71	6. 8.10	Place of marking.
	156	? Oct. (possibly Nov.) 10	nr. Oporto, Portugal.
	105	ca. 19.11.10	Co. Tipperary, Ireland.
	106	ca. 22.11.10	Co. Roscommon, Ireland.
	113	29.12.10	nr. Elvas, Alemtejo, Portugal.
	145	ca. 5. 2.11	Co. Cork, Ireland.
	154	13. 2.11	Co. Limerick, Ireland.
	283	ca. 1. 1.12	Co. Roscommon, Ireland.
1911 ...	271	17.10.11	Queen's Co., Ireland.
	336	7.11.11	Area of marking.
	400	20. 8.13	Place of marking.
	867	3. 7.15	Place of marking.
	824	20. 2.17	Co. Wicklow, Ireland.
1912 ...	395	2. 1.13	Anglesey, Wales.
	397	ca. 10. 1.13	nr. Guarda, Portugal.
	402	27. 8.13	Place of marking.
	817	24. 2.15	Cardigan, Wales.
	850	8.12.15	Place of marking.
	840	ca. 6. 2.17	Devon, England.
1913 ...	905	15. 8.13	Place of marking.
	401	20. 8.13	Place of marking.
	405	ca. 24. 1.14	Co. Mayo, Ireland.
	679	ca. 29. 1.14	Landes, France.
	407	ca. 5. 2.14	Co. Tipperary, Ireland.
	408	ca. 8. 2.14	Co. Galway, Ireland.
	681	ca. 20.11.14	Co. Limerick, Ireland.
	818	19. 2.15	Co. Roscommon, Ireland.
	852	13. 1.16	Place of marking.
	887	29.11.18	Place of marking.
1914 ...	620	early 9.14	Place of marking.
	813	23.12.14	Co Wicklow, Ireland.
	814	24.12.14	Co. Down, Ireland.
	853	13.12.15	Co. Clare, Ireland.
	821	23. 2.16	Area of marking (a few miles beyond boundary).
	829	13. 3.16	Co. Durham, England.
	870	early 1.17	Co. Cork, Ireland.
	842	8. 2.17	Co. Tipperary, Ireland.
	918	16. 1.20	Co. Durham, England.
1915 ...	844	24.11.16	nr. Oporto, Portugal.
	881	16.12.17	nr. Oporto, Portugal.

Table III. (*continued*).

Marked as chicks in central Scotland.

1910.....	274	30.12.11	Co. Westmeath, Ireland.
1912...	398	ca. 20. 1.13	Co. Mayo, Ireland.
	680	23.10.14	Queen's Co., Ireland.
	841	6. 2.17	Co. Sligo, Ireland.
1913...	406	ca. 2. 1.14	Co. Leitrim, Ireland.
	900	early 1.14	nr. Oviedo, northern Spain.
	832	–. 2.16	N. Cornwall, England.

Marked as chicks in the south-west of Scotland.

1912.....	396	11. 1.13	Queen's Co., Ireland.
1913...	898	early 1.14	nr. Oporto, Portugal.
	409	9. 1.14	nr. Oporto, Portugal.
1916.....	917	9.12.19	Co. Londonderry, Ireland.
1917...	886	ca. 10.12.17	Co. Londonderry, Ireland.
	896	ca. 21.10.18	Co. Sligo, Ireland.

Marked as chicks in the north of England.

1911.....	394	ca. 15.12.12	Co. Kildare, Ireland.
1912.....	393	2.12.12	Co. Kilkenny, Ireland.
1913.....	404	ca. 18. 1.14	Landes, France.

Marked as chicks in the south of England.

1912.....	399	19. 2.13	nr. place of marking.
1913.....	920	ca. 8. 5.20	nr. place of marking.

As the records from the various regions appear to be similar in character, the Scottish and north of England birds are treated as a single group for purposes of analysis, the two south of England cases being neglected. Table IV. gives the analysis according to the months in which the reappearances were recorded.

TABLE IV.

Seasonal Analysis of Reappearances of Lapwings marked as chicks in Scotland or the north of England.

Month.	Area of Marking.	*North of England.	*Wales.	*Devon and Cornwall.	Ireland.	S.W. France.	N. Spain.	Portugal.	Total.
May ...	—	—	—	—	—	—	—	—	0
June ...	1	—	—	—	—	—	—	—	1
July ...	2	—	—	—	—	—	—	—	2
Aug. ...	6	—	—	—	—	—	—	—	6
Sept. ...	1	—	—	—	—	—	—	—	1
Oct. ...	—	—	—	—	3	—	—	1	4
Nov. ...	2	—	—	—	4	—	—	1	7
Dec. ...	1	—	—	—	8	—	—	2	11
Jan. ...	1	1	1	—	6	2	1	4	16
Feb. ...	1	—	1	2	8	—	—	—	12
Mar. ...	—	1	—	—	—	—	—	—	1
Apr. ...	—	—	—	—	—	—	—	—	0
Totals...	15	2	2	2	29	2	1	8	61

(* All records under these headings relate to birds marked in N.E. or C. Scotland.)

The above table reveals the following facts :—

(*a*) A few birds are recorded in their native areas throughout the winter: considering the favourable conditions for records, the proportion remaining is probably a small one.

(*b*) Greater numbers are recorded from Ireland from October to February, representing about fifty per cent. of the whole list of records.

(*c*) Some are recorded from Portugal from October to January: considering the presumably unfavourable conditions for records, the proportion of birds these cases represent is probably a large one.

(*d*) A few birds are recorded from northern Spain, south-western France, and parts of Great Britain south of the localities of marking, but only, it so happens, in January and February.

(*e*) Despite the favourable conditions for records there is an entire absence of reappearances at places only a moderate

distance from those at which the birds were marked, and there are only a very few from more distant parts of Great Britain. The birds would therefore appear to be either definitely sedentary or definitely migratory, in the latter case performing comparatively quick journeys rather than gradual movements.

The number of Irish records justifies a supplementary analysis of these in more detail, and this is provided in Table V.

TABLE V.

Seasonal Analysis of Reappearances in Ireland of Lapwings marked as chicks in Scotland or the north of England.

Month.	Ulster.	Leinster.	Connaught.	Munster.	Total.
October	—	2	1	—	3
November	—	1	1	2	4
December	3	4	—	1	8
January	—	1	4	1	6
February	—	1	3	4	8
Total	3	9	9	8	29

From this table it is evident that the records are evenly distributed among the three southern provinces, but are few in number in Ulster. The only Ulster records, and the majority of those from Leinster, refer to the first half of the winter season, while most of the records from the other two provinces occur in the second half: this might be explained either by a local south-westerly movement during the winter or by longer journeys on the part of later arrivals from Great Britain, but the numbers, when thus subdivided, are rather small to be accepted as significant.

The following table analyses the same records as were dealt with in Table IV., but does so in accordance with the ages of the birds at the time of reappearance:—

TABLE VI.

AGE ANALYSIS OF REAPPEARANCES OF LAPWINGS MARKED AS CHICKS IN SCOTLAND OR THE NORTH OF ENGLAND.

Year of the bird's life.	Area of marking.		* England and Wales.	Ireland.	S.W. France and N. Spain.	Portugal.	Total.
	June–Sept.	Oct.–Feb.					
First year ...	6	1	1	16	3	6	33
Second year...	1	1	2	7	—	1	12
Third year ...	2	1	1	3	—	1	8
Fourth year...	—	1	—	1	—	—	2
Fifth year ...	1	—	1	1	—	—	3
Sixth year ...	—	1	1	1	—	—	3

(* See footnote to Table IV.)

The decreasing number of records in successive years naturally follows, of course, from the decreased total of survivors, but it may also represent a lower mortality rate after the first season. The records for the first three seasons suffice to show that age is an unimportant factor in determining the character of the movements performed.

The following table is similar to the foregoing, but is based on calendar years :—

TABLE VII.

ANNUAL ANALYSIS OF REAPPEARANCES OF LAPWINGS MARKED AS CHICKS IN SCOTLAND AND THE NORTH OF ENGLAND.

Year of Reappearance.	Area of Marking.		*England and Wales.	Ireland.	S.W. France and N. Spain.	Portugal	Total.
	June–Sept.	Oct.–Feb.					
1909–10...	1	—	—	—	—	—	1
1910–11...	2	—	—	4	—	2	8
1911–12...	—	1	—	3	—	—	4
1912–13...	—	—	1	4	—	1	6
1913–14...	4	—	—	5	3	3	15
1914–15...	2	—	1	5	—	—	8
1915–16...	1	3	2	1	—	—	7
1916–17...	—	—	1	4	—	1	6
1917–18...	—	—	—	1	—	1	2
1918–19...	—	1	—	1	—	—	2
1919–20...	—	—	1	1	—	—	2

(* See footnote to Table IV.)

The above table has been retained mainly as an example of the method employed, for, as has already been pointed out, excessive sub-division of the available total renders the separate items too small to be regarded as quantitatively significant.

Witherby (26) has a number of records, not yet published in collected or analysed form, of a similar nature to those dealt with in this section.

III.—THE WOODCOCK (*Scolopax rusticola* Linn.): ANALYSIS OF RECORDS.

As in the case of the previous species, the Woodcock is found in the British Isles throughout the year, but is known as a migrant to our coasts and from our coasts both in autumn and in spring. The problem is again, therefore, largely that of distinguishing the movements of the native birds from those of the winter visitors and birds of passage.

The results show several interesting features, and the details of the numbers marked, together with a complete list of the reappearances, are accordingly given in this instance also.

TABLE VIII.

NUMBERS OF WOODCOCK MARKED AND RECOVERED.

Season of marking as chicks.	Regions of Marking.							Numbers recovered (by seasons of marking).
	N. Scotland.	N.E. Scotland.	C. Scotland.	S. Scotland.	N. England.	Ireland.	Total.	
1910	2	8	2	1	—	1	14	3
1911	1	1	2	3	—	2	9	2
1912	2	2	36	2	3	—	45	6
1913	—	5	26	1	8	—	40	7
1914	—	1	16	23	—	—	40	2
1915	—	—	2	—	—	—	2	—
1916	—	—	3	—	—	—	3	1
1917	—	—	—	—	—	—	—	—
1918	—	—	—	—	—	1	1	—
Marked otherwise than as chicks.	—	—	—	2	—	—	2	—
Total	5	17	87	32	11	4	156	21
Numbers recovered (by regions of marking)	—	4	11	2	3	1	21	13·5%

TABLE IX.

List of Reappearances of Marked Woodcock.

Season of Marking.	Case No.	Date of Reappearance.	Locality of Reappearance.
Marked as chicks in the north-east of Scotland.			
1910	284	ca. 26.12.11	nr. place of marking.
1911	292	4. 1.12	Asturias, northern Spain.
1913	427	19. 8.14	nr. place of marking.
1914	621	8.10.14	Place of marking.
Marked as chicks in central Scotland.			
1911	300	28. 9.11	nr. place of marking.
1912 ...	416	17.11.12	Côtes-du-Nord, France.
	420	28.11.12	nr. place of marking.
	418	ca. 26.12.12	Co. Cork, Ireland.
	426	23. 2.14	Co. Antrim, Ireland.
1913 ...	421	4. 9.13	nr. place of marking.
	422	4. 9.13	nr. place of marking.
	423	13.11.13	Place of marking.
	425	ca. 20.11.13	Place of marking.
	816	24.12.14	nr. place of marking.
1916	827	25. 1.17	nr. place of marking.
Marked as chicks in the south of Scotland.			
1910	85	22. 8.10	Place of marking.
1914	815	4.12.14	Place of marking.
Marked as chicks in the north of England.			
1912 ...	417 same brood	13.11.12	Co. Cork, Ireland,
	419 same brood	28.12.12	Co. Cork, Ireland.
1913	424	7.11.13	nr. place of marking.
Marked as chicks in Ireland.			
1910	108	21.11.10	Place of marking.

For further treatment all the records of Woodcock marked in Scotland and the north of England have been grouped together, the only other record being neglected.

TABLE X.

Seasonal Analysis of Reappearances of Woodcock marked as chicks in Scotland or the north of England.

Month *.	Near place of marking.	Ireland.	N.W. France.	Northern Spain.	Total.
August	2	—	—	—	2
September	3	—	—	—	3
October	1	—	—	—	1
November	4	1	1	—	6
December	3	2	—	—	5
January	1	—	—	1	2
February	—	1	—	—	1
Total	14	4	1	1	20

(* No records for March, April, May, June or July.)

The seasonal analysis given above shows that :—

(*a*) Some of the Woodcock bred in Scotland and the north of England remain in their native districts throughout the winter.

(*b*) Others are recorded from Ireland from November to February, while there are also winter records from north-western France and northern Spain.

(*c*) There is an absence of records from Great Britain, other than from within a few miles of the respective places of marking, which suggests that the individuals are either definitely sedentary or definitely migratory.

Age Analysis. — Sixteen of the birds referred to in Table X. were recorded in their first winters, and four in their second ; the former figure includes all the records showing movement, except one from Ireland.

Annual Analysis.—The different types of record are well distributed over several calendar years.

Many records of this species are available from other sources, and these include several curious instances of winter movement in a northerly direction. A bird marked as a chick in Co. Tyrone was recovered in its first winter in Inverness-shire, but others were recorded from Cornwall and from Middlesex in their second winters (7). Birds marked as chicks in Northumberland reached Argyllshire and Forfarshire in their first winters, although another went to Ireland and one was recorded from Brittany in its third winter (14). Several winter records from the places of marking were also obtained during each of these investigations. Of 33 birds marked as chicks in Co. Sligo and subsequently recovered, all, except one from Spain, were reported either from the same neighbourhood or from within sixty miles at most, the records being almost exclusively for the winter months (6). Witherby (26) has also a number of records for this species.

IV.—HERRING-GULL (*Larus argentatus* Pontopp.): ANALYSIS OF RECORDS.

The Herring-Gull is found all the year round in the British Isles, immature birds remaining in summer in many districts where no suitable breeding-places exist. By purely observational means it is not possible to determine the nature of the wandering movements that appear to take place in winter.

During the course of the Inquiry, 461 birds of this species were marked, 375 of them in the northeast of Scotland. Of the latter, 289 were marked as chicks, and 86 as full-grown birds caught on the shore at night and mainly in September and October 1910, and it is these two categories which have provided nearly all the records. The two sets of reappearances are treated separately below, as they reveal certain differences which are doubtless due to one category consisting entirely of native birds while the other may contain at least a proportion of winter visitors.

TABLE XI.

List of Reappearances of Herring-Gulls marked as chicks on the Aberdeenshire coast.

Season of Marking.	Case No.	Date of Reappearance.	Locality of Reappearance.
1910 ...	153	–. 9.10	Co. Durham.
	89	8. 9.10	Lincolnshire.
	93	13. 9.10	Aberdeenshire.
	94	1.10.10	Lincolnshire.
	92	3.10.10	Norfolk.
	101	ca. 4.10.10	Fifeshire.
	97	ca.12.10.10	Fifeshire.
	121	ca.30. 1.11 (released 7.3.11)	Lancashire.
		1. 8.13	Nairnshire.
	277	26.11.11	Co. Durham.
1911 ...	254	7. 9.11	Yorkshire.
	369	14. 2.12	Norfolk.
	373	19.11.12	Yorkshire.
1912 ...	368	ca. 29. 8.12	Banffshire.
	370	9. 9.12	Heligoland.
	372	ca. 15. 9.12	Aberdeenshire.
	371	30. 9.12	Monmouthshire.

TABLE XII.

Seasonal Analysis of Reappearances of Herring-Gulls marked as chicks on the Aberdeenshire coast.

Month.	Aberdeenshire and Moray Firth.	Fifeshire.	Durham and Yorkshire.	Lincolnshire and Norfolk.	Lancashire and Monmouthshire.	Heligoland.	Total.
August	2	—	—	—	—	—	2
September ...	2	—	2	1	1	1	7
October	—	2	—	2	—	—	4
November ...	—	—	2	—	—	—	2
December ...	—	—	—	—	—	—	—
January	—	—	—	—	1	—	1
February ...	—	—	—	1	—	—	1
Total ...	4	2	4	4	2	1	17*

(* Two records refer to the same bird (Case 121).)

The age analysis shows that all the records refer to the first year of the birds' lives with the exception of two in the second year (Co. Durham and Yorkshire) and one in the fourth year (Moray Firth). The annual analysis merely reflects the numbers marked in the different seasons.

There is a noteworthy absence of any winter records from the district of marking, although the conditions there are favourable and the species gives a good percentage of re-appearances. A southward wandering, mainly along the east coast of Great Britain, is clearly indicated, and one bird is shown to have crossed the North Sea to Heligoland as early as 9th September in its first autumn.

The records contrast markedly with those for the Lapwing and the Woodcock in revealing no gap between the native district and a comparatively distant winter area. This may be taken as an expression of a different type of migration, a gradual dispersal with a southerly trend rather than a definite and rapid change of area.

TABLE XIII.

List of Reappearances of Herring-Gulls caught on the shore at night, marked and released, near Aberdeen, in September and October 1910.

Case No.	Date of Reappearance.	Locality of Reappearance.
104	15.11.10	Aberdeen.
205	20. 5.11 (and released)	Burray, Orkney.
	11. 1.13	nr. Aberdeen.
217	26. 6.11	Aberdeen.
333	7. 3.12	Aberdeenshire.
334	6. 5.12	Asaa, east coast of Jutland, Denmark.
374	27. 6.13	Gera, Thuringia, Germany.
375	28. 4.14	Caithness.

TABLE XIV.

Seasonal Analysis of Reappearances of Herring-Gulls caught on the shore at night, marked and released, near Aberdeen, September and October 1910.

Month.	Aberdeenshire.	Orkney Islands and Caithness.	Denmark and Germany.	Total.
November ...	1	—	—	1
December ...	—	—	—	—
January	1	—	—	1
February ..	—	—	—	—
March.....	1	—	—	1
April	—	1	—	1
May	—	1	1	2
June	1	—	1	2
Total ..	4	2	2	8*

(* Two records refer to the same bird (Case 205).)

Of the above, 3 were recovered in the first year after marking, 2 in the second, 2 in the third, and 1 in the fourth.

Although the number of records is not great it is sufficient to show that the Herring-Gulls found on the Scottish coast in the late autumn are of a category different from the native birds, thus bearing out the conclusion that most of the latter move southwards in winter. The differences include winter records from the area of marking and summer records from farther north and from the Continent. Case 205 is of special interest in showing that the bird returned to the same winter area after having been to the Orkney Islands in an intervening summer.

Taking both sets of data together it seems fair to conclude that our native birds tend to wander southwards in winter, mainly within the British area, and that Continental birds appear as winter visitors.

In addition to the two sets of records dealt with above, Herring-Gulls marked as chicks in 1910 in the Lewis, Outer Hebrides (Case 112), and in Berwickshire (Case 232), were recorded from the same localities on 5.12.10 and 3.8.11 respectively.

V.—THE BLACK-HEADED GULL (*Larus ridibundus* Linn.): ANALYSIS OF RECORDS.

The Black-headed Gull is found all the year round in the British Isles, and, as in the case of other sea-birds, its migratory movements are difficult to distinguish. During the course of the inquiry, 1,150 were marked, 316 of them as chicks in the northeast of Scotland and 294 as chicks in the north of England. The reappearances number 27 in all, or 2·3 per cent.

Of those marked as chicks in the northeast of Scotland, 12 were recovered as follows:—8 from the same or a neighbouring district, 2 from more southerly parts of Scotland, 1 (Case 390) from Co. Down, Ireland, and 1 (Case 116) from near Bayonne, Basses-Pyrénées, France.

Of birds marked as chicks in central Scotland, 4 were recovered as follows:—3 from the same district or slightly to the south, and 1 from the extreme southwest of Scotland.

Of those marked as chicks in the north of England, 10 were recovered, all from the area of marking.

TABLE XV.

SEASONAL ANALYSIS OF REAPPEARANCES OF BLACK-HEADED GULLS MARKED AS CHICKS IN SCOTLAND AND THE NORTH OF ENGLAND.

Month of Reappearances *.	Great Britain.		Ireland.	S.W. France.	Total.
	In or near area of marking.	Over 100 miles south of place of marking.			
June	1	—	—	—	1
July	3	—	—	—	3
August	6	—	—	—	6
September ...	6	—	—	—	6
October	3	1	—	—	4
November ...	1	—	—	—	1
December ...	—	—	1	—	1
January.....	—	—	—	1	1
February ...	1	2	—	—	3
Total	21	3	1	1	26

(* No records for March, April, or May.)

Of the above, 22 reappeared during their first year, 2 during their second, 1 in its third, and 1 in its fourth.

The first column of the seasonal analysis indicates that the native birds decrease in numbers in winter in Scotland and the north of England, and there is indeed no evidence from this source that any remain throughout. The other columns show that the birds may reach Ireland and south-western France.

There is also one isolated record (Case 229) of a bird marked otherwise than as a nestling ; one of four birds marked at night on the shore near Aberdeen on 3. 10. 10 was recovered near the same place on 20. 7. 11.

Witherby's records (26) include a Black-headed Gull marked in Yorkshire and recovered from the Azores in its first winter, and another marked as a chick in Cumberland in 1910 and reported from Aberdeenshire, over 200 miles farther north, on 20. 2. 11. The species has also been studied by Thienemann (16), birds marked as chicks at Rossitten, at the south-eastern corner of the Baltic, being reported in winter as far afield as the south of England, the Bay of Biscay, the Balearic Isles, the south of Italy, and Tunis.

VI.—THE MALLARD (*Anas boschas* Linn.): ANALYSIS OF RECORDS.

The Mallard is found all the year round in the British Isles, but it is known to be a winter visitor and a bird of passage as well as a resident, and, as in so many other cases, the first problem is accordingly the separation of the movements performed by the native and immigrant birds respectively. Birds of this species are frequently hand-reared, often from eggs imported from other districts, and it is to cases of this kind that most of the records refer.

Many hand-reared ducklings were marked at Pitcaple Castle, Aberdeenshire, in 1910, but owing to the loss of some of the notes the total is uncertain. Of these, 13 were recovered, ten of them in the same district (seven on the

same estate) during their first winter, one in the same district in the summer of 1912, and the other two as follows:— Case 367 at Gottrüp, Aalborg, northern Denmark, on 18 July 1911, and Case 738 at Osterley, Upland, Sweden (110 km. north of Upsala), on 10 August 1913; the former was described as a mother in charge of a large brood of ducklings.

Of 31 hand-reared ducklings marked at Dunecht House, Aberdeenshire, in 1911, 13 were recovered in the same district (11 on the same estate) in their first season (9 on 31 August, 2 in November, 1 in December, and 1 in January). Of 67 hand-reared ducklings marked at the same place in 1912, 38 were recovered in the same district (36 on the same estate), 35 in their first season (31 in September and October, 2 in November, and 2 in December), and 3 in their second season (1 in June with a brood of young, 1 in October, and 1 in January). Of 11 marked at the same place in 1913 none was recovered. Of hand-reared ducklings marked elsewhere in Aberdeenshire, 3 were recovered in the same district, 1 of them in its first season and 2 in their second.

At Leadenham House, Lincolnshire, 38 hand-reared ducklings were marked in 1912, and 19 of these were recovered on the same estate, 15 in their first winter and 4 in their second. In 1913, 28 were marked there, and 2 of these were recovered at the same place on 4 October of that year. A hand-reared duckling marked in Hampshire was recovered at the place of marking in its first winter.

Of birds marked as wild ducklings, five marked in Aberdeenshire (two), Inverness-shire, Berwickshire, and Co. Monaghan respectively were recovered at the places of marking in their first seasons; and one marked in Aberdeenshire was recovered there on the 1st of August of its third year.

Bearing in mind that most of the birds referred to were hand-reared, the following conclusions may be drawn. With two exceptions all the birds were recovered at or very near

the places where they were marked, and as the percentage is very high, in some instances over fifty, it is evident that the native birds are resident and stationary in high degree, there being no evidence of even local movements.

The two exceptions are of peculiar interest, for in each case the bird was found in a totally different summer area. This fact is difficult to explain in view of the normal sedentary habit of our native birds as shown by the great majority of the records, and it accordingly seems likely that these cases are abnormal. A not improbable explanation would be that the birds became attached to a company of winter visitors of the species and were so led to perform a spring migration to a new breeding area across the North Sea. Witherby (26) has a similar record, an Essex bred bird having been reported from West Prussia in its second summer, and the Shield-duck (*cf.* Section X.) has also afforded instances of a like nature. Witherby has only one other record of a native Mallard which shows any migratory movement, as against fifty-three wild and twenty-six hand-reared birds recovered at home ; but of eight birds marked in Wigtonshire in winter, one was reported in winter from the north of Ireland and seven in summer or late autumn from Finland and Sweden.

VII.—THE STARLING (*Sturnus vulgaris* Linn.): ANALYSIS OF RECORDS.

The movements of the Starling in the British area, as studied by other methods, have already been fully worked out (*cf.* Eagle Clarke, Report Brit. Assoc., 1903, p. 291). Although found all the year round it is known, both as an autumn immigrant from north-western and from western and central Europe, and as an emigrant to the south at the same season : late "weather movements" in severe winters also occur, including renewed emigration. The corresponding reverse movements may be observed in spring. The first problem is accordingly once more the separation

of native birds from the winter visitors and birds of passage.

The data available as the result of this inquiry fall under the following heads :—Birds marked as nestlings, birds caught and marked in summer, birds caught and marked in winter, and birds caught and marked on migration at lighthouses. The first two categories consist of obviously native birds, the third of a mixture of native birds and winter visitors, as will be seen, and the fourth either of a similar mixture or entirely of winter visitors and birds of passage. The four groups have accordingly been analysed separately, the first two being afterwards discussed in conjunction.

TABLE XVI.

Numbers of Starlings Marked and Recovered.

How marked.	Numbers marked.	Numbers recovered (by categories of marking).
As nestlings	877	15
Caught in summer	76	7
Caught in winter	732	36
Caught at lighthouses on migration	215	4
Total	1,900	62

The percentage of birds recovered, calculated on the total, is thus 3·3. As the numbers of this species marked are relatively large, the higher proportion of reappearances among birds which were caught for marking, as compared with those marked as nestlings, is at first sight rather striking ; the records of the caught birds, however, are to a large extent due to the trapping activities of the markers at particular places, and the number of reappearances has thus become inflated.

TABLE XVII.

Summary of Reappearances of Starlings marked as nestlings in Great Britain.

Reported from near place of marking (maximum distance 25 miles).	
Numbers reported.	Season of reappearance.
4	Summer of marking.
3	First winter.
1	Second summer.
2	Second winter.
3	Third summer.
1	Fourth summer.
Reported at a distance from place of marking.	
Case 457 : Marked at Beaulieu, Hampshire, on 19.5.13 ; shot at Porthleven, Cornwall, on 17.1.14.	

Of Starlings caught and marked in summer in Great Britain otherwise than as nestlings, three reappeared in the summer of marking, three in their first winter, and one in its second summer, in every case at or near the place of marking.

Taking these latter records and those summarised in Table XVII., it is at once evident that at least some of the native Starlings are stationary and that there is little evidence of even local movements of more than a few miles. In one case, only, a journey of about 130 miles was performed. The number of birds marked seems sufficiently high, and the chance of recoveries being reported sufficiently good, for the absence of other records to be regarded as significant.

TABLE XVIII.

Summary of Reappearances of Starlings caught and marked in winter in Great Britain.

Reported from near place of marking.	
* Numbers reported.	Season of reappearance.
7	Same winter.
10	First summer.
1	Same winter and again in second winter.
7	Second winter.
1	Second winter and again in second summer.
3	Third winter.
1	Fourth winter.
1	Fourth summer.

Reported at a distance from place of marking.

Case 308: Marked at North Berwick, East Lothian, on 24.12.10; caught at Hartlepool, Co. Durham, on 6.2.12.

Case 218: Marked at Edinburgh on 20.3.11; killed at Saltdalen, Arctic Norway, on 20.4.11.

Case 246: Marked at Aberdeen on 20.1.10; found dead at Kvarv i Salten, Arctic Norway, about 20.8.11.

Case 455: Marked at Edinburgh on 18.3.11; caught (believed to be nesting) at Vaardalsören, Nord-Trondhjem, Norway, on 5.4.13.

Case 459: Marked at Edinburgh on 10.2.11; caught near Christiania, Norway, on 11.3.14.

(* Each individual counted once only.)

The records given in Table XVIII. include instances of birds caught in winter and recovered at the same places in summer, thus affording further evidence of the stationary habit of the native birds. The records of birds recovered in winter, including the one case showing movement, are not significant, as it is impossible to say whether the birds were resident individuals or winter visitors.

The four cases of birds recovered in Norway, three of them from the part of that country lying near the Arctic Circle, serve to indicate the summer quarters of at least some of the birds which reach the British Isles in winter.

Finally there are the following reappearance records of Starlings which were marked on migration at British lighthouses :—

Case 458: Marked at night at the lighthouse, Isle of May, Firth of Forth, on 12.10.13 ;
killed near Omerbane, Co. Antrim, Ireland, on 29.1.14.

Case 456: Marked at night at St. Catherine's Lighthouse, Isle of Wight, on 23.11.13 ;
killed at St. Andrew's, Guernsey, on 6.1.14.

Case 822: Marked at night at St. Catherine's Lighthouse, Isle of Wight, on 13.3.15 ;
caught near Walsall, Staffordshire, on 25.12.16.

Case 452: Marked at night at the Skerries Lighthouse, off Anglesey, North Wales, on 23.10.12 ;
caught at Svendborg, Denmark, about 10.5.14.

Of these records, Case 452 was obviously a winter visitor and Case 458 not improbably the same ; the other two may have been native birds, but in view of the conclusions already suggested it is of interest that in all the instances of this kind there is at least a possibility that the subjects were winter immigrants.

Witherby (26) has a number of records not yet published in collected form, and the species has also been largely studied by Mortensen (9, 11, 12).

VIII.—THE SONG-THRUSH (*Turdus musicus* Linn.): ANALYSIS OF RECORDS.

The very complex movements of this species have been fully worked out by other methods (*cf.* Eagle Clarke, Report Brit. Assoc., 1900, p. 404 ; also B. O. C. Migration Reports), and it is known that different individuals may be respectively residents, summer visitors, winter visitors, or birds of passage. Most of the records here available refer

to undoubted native birds, only a comparatively small number having been marked in winter. The total number marked was 3,770, the highest figure in the inquiry for any one species, and the total number recovered was 52, or 1·4 per cent.

TABLE XIX.

Seasonal Analysis of Reappearances of Song-Thrushes marked as nestlings in Scotland or the north of England.

Month of Reappearance.	Year of bird's life in which reappearance occurred, and locality of reappearance.			Total.
	First year.	Second year.	Subsequent years.	
May	—	1 at place of marking.	—	1
June	—	1 at place of marking.	—	1
July	11 near places of marking.	2 at places of marking.	—	13
August	6 near places of marking.	—	—	6
September	1 at place of marking.	1 at place of marking.	(Sixth year) 1 at place of marking.	3
October	—	—	—	—
November	1 in Portugal.	—	—	1
December	1 forty miles south of place of marking.	—	—	1
January	1 in Sussex.	1 at place of marking.	(Third year) 1 at place of marking.	3
February	1 at the Eddystone Lighthouse.	—	—	1
March	—	—	(Ninth year) 1 at place of marking.	1
April	1 at place of marking.	2 near places of marking.	—	3
Total	23	8	3	34

The following fuller particulars of certain cases included above may be added :—

Case 102 : Marked as a nestling in Aberdeenshire on 4.6.10 ; shot 70 miles north of Lisbon on 6.11.10.

Case 613 : Marked as a nestling in Aberdeenshire on 10.6.11 ; found dead at Arundel, west Sussex, end of January 1912.

Case 596 : Marked as a nestling in Aberdeenshire on 19.5.13 ; recovered at the Eddystone Lighthouse, in company with other birds, on the night 27/28.2.14.

Case 922 : Marked as a nestling on the Isle of May, Fifeshire, on 20.5.11 and found dead at the same place in March 1920—nearly nine years later.

Of Song-Thrushes marked as nestlings at Beaulieu, Hampshire, in April 1912, one (Case 617) was caught at Bridgewater, Somerset, on 2. 11. 12, and one (Case 597) was recovered at St. Catherine's Lighthouse, Isle of Wight, on the night 9/10. 2. 13. Three birds marked as nestlings at Dawlish, Devon, were recovered at the same place in winter, two in their first year and one in its second.

Thirteen Song-Thrushes marked in Great Britain otherwise than as nestlings were recovered, all at the places of marking. Two of these had been marked in summer and reappeared respectively in the summer of the fourth year and in the winter of the first. Of the remainder, all marked in winter, two reappeared in summer, four in the winter of marking, four in subsequent winters, and one was recorded six times in all during the following summer and winter.

The data given above suffice to show that some of the British native Song-Thrushes (belonging to the race *Turdus musicus clarkii* Hartert) are resident, while others are summer visitors. The number of positive records showing migration is not large, but the scarcity of winter records from the area of marking, in the case of birds marked in summer, may perhaps be taken as evidence of a negative kind in support of the same conclusion.

Witherby's records (26) include a Song-Thrush which migrated from Yorkshire to the north of France, and another which travelled from Westmorland to Co. Clare, Ireland.

IX.—THE HEDGE-SPARROW (*Accentor modularis* Linn.): ANALYSIS OF RECORDS.

The total number of birds of this species which were marked is 898, and 66 of these, or 7·3 per cent., were recovered. A further analysis of these figures, however, reveals a striking fact which must be borne in mind when considering the results: of 142 marked at East Warriston, Edinburgh, 42, or 29·6 per cent., were recovered, many of them several times; of 131 marked at Beaulieu, Hampshire, 17, or 13·0 per cent., were recovered; and of the 625 marked elsewhere, 7, or only 1·1 per cent., were recovered. The records for the East Warriston and Beaulieu birds are largely accounted for by the continued trapping activities of the markers at these places, especially at the former, and the small chances of a bird being recorded through any other agency make it quite impossible to lay stress on such negative evidence as the absence of records from places other than those of marking. Similar considerations apply to certain of the species more briefly discussed in Section X., notably the Greenfinch, the House-Sparrow, the Great Titmouse, the Blue Titmouse, and the Redbreast.

All the records obtained refer to birds recaptured at the places of marking, and the seasons of reappearance are shown in the following table: the records for Scotland form the majority, but those for England are given in the same table as no differences are apparent.

It may be concluded that at least some of the native Hedge-Sparrows are absolutely sedentary, but it has already been pointed out that the absence of records showing movement on the part of other individuals may be without real significance. (It may be added that the ordinary observer

TABLE XX.

Summary of Records of Hedge-Sparrows marked in Great Britain and recovered at the places of marking.

How marked.	Season of reappearance.	*Numbers recovered.
As nestlings	Same summer only	1
	Same summer and 1st winter	1
	1st winter	3
	2nd summer	1
	5th summer	1
	Total	7
Caught and marked in summer.	Same summer only	2
	Same summer and 1st winter	2
	Same summer, 1st winter, and 2nd summer	1
	1st winter	3
	Total	8
Caught and marked in winter.	Same winter only	28
	Same winter and 1st summer	2
	Same and 2nd winters	2
	Same, 2nd, and 3rd winters	2
	Same and 3rd winters	1
	1st summer	2
	2nd winter	9
	2nd and 3rd winters	1
	2nd summer	1
	3rd winter	3
	Total	51

(* Each individual counted once only.)

cannot be expected to distinguish between the resident British race and the Continental race which is known as a migrant in the British Isles.)

X.—SUMMARY OF RECORDS OF OTHER SPECIES.

SWALLOW (*Hirundo rustica* Linn.).

There are three records of birds of this typically migratory species returning to the localities of marking in the following seasons. Two were marked as nestlings and one as an adult, the details being as follows :—

Case 15: Caught, marked, and released as an adult bird at a farm in Kent on 29 June, 1909; recaught at the same farm on 14 June, 1910.

Case 201: Marked as a nestling in Kincardineshire on 21 August, 1910; found with a broken wing in the same village on 22 May, 1911.

Case 483: Marked as a nestling at Beaulieu, Hampshire, on 6 September, 1912; caught in an outhouse, where it was believed to be nesting, at Ringwood, Hampshire, about eighteen miles from its birthplace, on 2 May, 1913.

There are also two records of birds marked as nestlings being recorded from the places of marking in their first season : in one instance (Case 871) the date of recovery was as late as the 30th of October.

It would be of special interest to compare the winter-quarters of British-bred Swallows with those of Swallows from other countries, in view of the statement made by Hartert (Vög. der paläarkt. Fauna, i. p. 801) that "doubtless the most northerly dwellers migrate further south while the breeding birds of the Atlas Mountain region probably go only to the oases of the Sahara for the winter." Unfortunately the proportion of records of value must always be very small, although Witherby (26) has had three marked Swallows of British origin reported to him from South Africa.

GREENFINCH (*Chloris chloris* Linn.).

The only record revealing any movement is of a bird (Case 311) caught and marked at Inverurie, Aberdeenshire, on 23 August, 1910, and recaught at Melvich, Sutherland, about 12 February, 1912. The remaining

forty-four recorded birds all reappeared at the places where they were marked, or at most two or three miles distant.

Of three birds marked in Scotland in summer, one marked as an adult and one as a nestling were recovered in the following winter, and one marked as a nestling was recovered in summer two years later. Of birds caught and marked in Edinburgh during the period December–March, in various calendar years, twenty-eight reappeared in the same winter, four in their first spring (April), and six in the following winter. In several instances the birds were recorded more than once. There are also three other isolated records of little interest.

As most of the birds were marked in winter the results recorded above do little to help to differentiate the native birds from those that are winter visitors from the Continent.

GOLDFINCH (*Carduelis carduelis* Linn.).

One (Case 847) marked as a nestling near Dawlish, Devonshire, on 5 August, 1913, was found dead at the same place on 4 February, 1915.

CHAFFINCH (*Fringilla cœlebs* Linn.).

All the reappearances of marked birds of this species refer to the respective localities of marking, in most cases actually to the same gardens. One bird caught and marked in summer in Argyllshire was recovered in the third winter; one marked as a nestling in Kincardineshire was recovered in the same summer; one marked as a nestling in Devon was recovered in the following summer; one marked as a nestling in Hampshire reappeared four times in its first winter; and one caught and marked in Hampshire in summer reappeared once in the second winter and twice in the third.

Of birds caught and marked in Hampshire in winter, three reappeared there in the same winter and six in the following one: one of the latter also reappeared in September nearly four years after the date of its marking. One of these birds reappeared no less than seven times during a single season.

Although all the birds marked in winter were, with one exception, recorded again only from October to March, this may well be attributed to the netting activities of the marker at that time of year. Two birds caught and marked in Aberdeenshire in winter were recovered in the following winter, and one marked early in March reappeared six weeks later.

HOUSE-SPARROW (*Passer domesticus* Linn.).

Seventy-one marked birds of this species were recovered, all of them at the places where they were marked, which were for the most part in Scotland although several records refer to Hampshire. Most of the birds were caught and marked in winter and recovered in the same season of the year, but there is a good proportion of records of birds marked in winter and recovered in summer and *vice versa*. The longest interval was three and a half years. The records tend to bear out the supposition that the species is practically sedentary despite its occasional appearance at light-stations.

GREAT TITMOUSE (*Parus major* Linn.).

All the reappearances of marked birds of this species refer to the places of marking, usually to the identical gardens. One bird marked as a nestling in Aberdeenshire was recovered in the following winter ; two birds marked in Bute in spring were recovered in their first and fourth winters respectively.

Twenty-eight birds caught and marked in Scotland (two localities in Aberdeenshire and one in Mid-Lothian) in winter, were recovered as follows :—sixteen during the same winter, one in the first summer, five in the second winter, one in the second winter and second summer, one in the second summer, two in the second and third winters, and two in the third winter only. One bird caught and marked in Hampshire was recovered five times during the following winter. The preponderance of winter reappearances is doubtless largely due to the netting activities of the markers at that season, most of the records coming from that source.

BLUE TITMOUSE (*Parus cæruleus* Linn.).

A total of 653 birds was marked, of which 70, or 10·7 per cent., reappeared. All the birds were recovered at the places of marking, and in nearly every case owing to the trapping activities of the markers. The figures for the species indeed illustrate exceedingly well the point already brought out in the case of the Hedge-Sparrow (*cf.* Section IX.). Of 41 caught and marked in winter at Old Aberdeen, 37, or 90·2 per cent., were recovered; of 15 caught and marked in winter at East Warriston, Edinburgh, 8, or 53·3 per cent., were recovered; of 43 caught and marked in winter at Beaulieu, Hampshire, 19, or 44·2 per cent., were recovered; while of 554 marked otherwise than under these conditions—mainly in summer—6, or only 1·1 per cent., reappeared.

In all, 66 birds marked in winter reappeared in winter, in some cases as late as the third year, and three marked as nestlings and one caught and marked in summer also reappeared in winter. Individual birds were frequently recovered many times, in one instance on eleven separate occasions. All the records refer to Great Britain.

MISTLE-THRUSH (*Turdus viscivorus* Linn.).

One (Case 619) marked near York as a nestling was recovered in the same district in December of the same year.

BLACKBIRD (*Turdus merula* Linn.).

During the course of the inquiry 2,641 Blackbirds were marked and 68 were recovered, making 2·6 per cent. The only instance of migratory movement is Case 278, which was marked as a nestling in Aberdeenshire on 12.6.11 and found dead near Gateshead, Co. Durham, on 7.11.11. All the other records refer to birds recovered at or near the places of marking, including a few from distances up to about thirty miles. Of birds marked in Great Britain as nestlings, thirty-one were thus recovered, thirteen of them during the

summer of marking, seven of them in subsequent summers, ten of them in subsequent winters, and the remaining one in its first winter and again in its second summer. Of birds marked in Great Britain otherwise than as nestlings, sixteen that were marked in summer and nineteen that were marked in winter reappeared, and the records show a similar even distribution between subsequent summers and winters as in the case of those marked as nestlings. One bird caught and marked in Ireland in winter was recovered at the place of marking in its fourth winter.

These records show that at least some of the native Blackbirds are resident and stationary, and there is indeed only one case giving evidence of appreciable movement. Witherby's records (26) include a Blackbird marked in Dumfries-shire and recovered in Co. Down, Ireland, in its second winter.

REDBREAST (*Erithacus rubecula* Linn.).

Of the 1,206 birds marked, 61, or 5·1 per cent., were recovered—all of them at the places of marking and indeed very frequently in the identical gardens. In many instances individual birds were recaptured several times. Of eighteen birds marked in Great Britain in summer, as nestlings or otherwise, one was recovered in the same summer, three in subsequent summers, and fourteen in winter. Of forty-two marked in Great Britain in winter, twenty-six were recovered in the winter of marking, thirteen in subsequent winters, and three in summer. There is also one Irish record of no interest.

The records show that at least some of the native Redbreasts are absolutely sedentary. There is no evidence of even local movements, but much stress cannot be laid on the absence of records, owing to the fact that the chances of a bird of this species reappearing seem to be very small apart from the marker's own recaptures. Figures illustrating this point have already been given for the Hedge-Sparrow and the Blue Titmouse, to which similar considerations apply.

SPOTTED FLYCATCHER (*Muscicapa grisola* Linn.).

Two adult birds (Cases 484 and 485) caught on their nests near Edinburgh were recaught at the same place a year later. As this species is completely absent from the British Isles in winter the records are of some interest as evidence of migrants returning to the same breeding-places.

MEADOW-PIPIT (*Anthus pratensis* Linn.).

One (Case 275), considered by the marker to be a male of the year, was caught, marked and released near Bromford, Warwickshire, on 20 September, 1911, and was shot near Lisbon, Portugal, about 7 December of the same year.

Witherby (26) has three records of British-bred Meadow-Pipits from south-western France, one from Portugal, and no winter records from the British Isles. (The species is found all the year round in the British Isles, but is known in autumn both as an immigrant and as an emigrant.)

SWIFT (*Apus apus* Linn.).

An adult (Case 919) caught and marked in its nesting-hole in Ayrshire on 11. 6. 14, was recaught at the same place on 5. 6. 18.

CUCKOO (*Cuculus canorus* Linn.).

One (Case 251) marked as a nestling near Newark, Nottinghamshire, on 30 June, 1911, was shot on the Sea Bank at Boston, Lincolnshire, on 2 September of the same year.

BARN-OWL (*Flammea flammea* Linn.).

Two nestlings of the same brood (Cases 453 and 454) marked in Staffordshire on 22 July, 1913, were recovered in the same district about 6 January and 4 March, 1914, respectively.

HERON (*Ardea purpurea* Linn.).

Three marked as nestlings, in Aberdeenshire, Dumbartonshire, and Yorkshire respectively, were recovered within short distances of the places of marking during either their first or second winters.

Mortensen (11) has found this species highly migratory, Danish-bred birds reaching southern England, Brittany, and southern Spain.

SHELD-DUCK (*Tadorna tadorna* Linn.).

Of a brood of ducklings marked in Hampshire on 16 July, 1912, the following reappeared :—

Case 447 : 10 Feb. 1913, Saltash, Cornwall.
Case 448 : ca. 12 Aug. 1913, Büsum, Schleswig-Holstein, Germany.
Case 906 : 18 Aug. 1917, Mouth of the Weser, Germany.

The eastward wandering in two cases is curious and suggests that of the two Mallards previously referred to in Section VI. : the explanation already put forward might also apply here, although in the absence of other records one cannot be so certain that these are exceptional instances.

TEAL (*Querquedula crecca* Linn.).

One (Case 446) marked as a duckling in Inverness-shire on 29 May, 1912, was shot in County Waterford, Ireland, on 5 February, 1914. The only other record is of no interest.

Teal marked in Denmark by Mortensen (10), having been caught in decoys on autumn passage, have been recovered in Holland, England, Ireland, and France, and in southern Spain and northern Italy.

WIGEON (*Mareca penelope* Linn.).

Of a brood of five ducklings marked in the east of Sutherland, Scotland, on 19 June, 1909, the following were recorded :—

Case 4 : 3 Sept. 1909, Ulrum, Groningen, Holland.
Case 118 : ca. 2 Jan. 1911, River Trent, Nottinghamshire.

The species is chiefly known in the British Isles as a winter visitor or bird of passage, and this slight evidence of movement on the part of native birds is of some interest.

WOOD-PIGEON (*Columba palumbus* Linn.).

Twelve birds marked as nestlings in various parts of Scotland were subsequently recorded, ten of them from

within a few miles of the places of marking. Of these ten records, four refer to the summer of marking, two to the following winter (February and March), three to subsequent summers (after 1, 2, and 3 years respectively), and one to the bird's third winter (February). The remaining cases exhibit movement :—

Case 440 : Marked as a nestling at Inverurie, Aberdeenshire, on 5 June, 1913 ;
shot near Montrose, Forfarshire, in November of the same year.

Case 441 : Marked as a nestling at Beith, Ayrshire, on 27 May, 1913 ;
shot at Shifnal, Shropshire, on 23 January, 1914.

The species is both a resident in the British Isles and a winter visitor in very variable numbers : the local movements of the two categories are not distinguishable by other methods than that of marking.

GOLDEN PLOVER (*Charadrius apricarius* Linn.).

One (Case 263) marked as a chick in Inverness-shire on 21 May, 1911, was shot in County Mayo, Ireland, about 13 October of the same year.

RINGED PLOVER (*Ægialitis hiaticula* Linn.).

One (Case 825) marked as a chick in East Lothian was recovered in the same district after four years and eight months.

DUNLIN (*Tringa alpina* Linn.).

One (Case 411) marked as an adult caught on its nest on the Pentland Skerries, Orkney Islands, was recovered within fifty yards of the same spot ten months later.

Dunlins caught on passage at Rossitten, East Prussia, have been recorded by Thienemann (16) from Essex, the Gironde estuary, and the Rhone delta.

CURLEW (*Numenius arquata* Linn.).

One (Case 412) marked as a chick in Inverness-shire on 1 June, 1912, was shot in County Tyrone, Ireland, on the

5 August of the same year. One (Case 921) marked as a chick in Northumberland on 18 June, 1912, was found dead in the same district on 6 May, 1920.

OYSTERCATCHER (*Hæmatopus ostralegus* Linn.).

One (Case 856) marked as a chick in Aberdeenshire on 11 June, 1910, was recovered in Cheshire on 3 December, 1915. Two (Cases 413 and 414) marked as chicks in Aberdeenshire in June 1912, were shot in Ireland in the same autumn, one at Broadhaven Lighthouse, County Mayo, on 22 August, and the other at Blackrock, County Cork, in October. A fourth (Case 904) was marked as a chick in Sutherland on 29 May, 1913, and recovered in the neighbouring county of Ross about 13 August of the same year.

An autumn migration of Oystercatchers from Scotland to Ireland was already known to occur, but whether partly of native birds or wholly of winter visitors was not established. The early dates in two cases are of interest.

SNIPE (*Gallinago gallinago* Linn.).

One (Case 415) marked as a chick in County Fermanagh, Ireland, on 12 June, 1913, was shot in County Longford on 6 October of the same year.

COMMON TERN (*Sterna hirundo* Linn.).

One (Case 392) marked as a chick on the Aberdeenshire coast on 31 July, 1912, was picked up in the Firth of Forth about 7 September of the same year. Five others marked as chicks in various parts of Scotland were recovered near places where they were marked after intervals of less than two months (two on 21 August, and the others even earlier).

LITTLE TERN (*Sterna minuta* Linn.).

One (Case 678) marked as a chick on the Yorkshire coast on 10 July, 1914, was recovered in Portugal in September of the same year.

COMMON GULL (*Larus canus* Linn.).

One (Case 376) marked as a chick on the mainland, Shetland Isles, on 22 June, 1912, was recovered in Norfolk on 8 September of the same year. Two (Cases 253 and 276) marked as chicks in Argyllshire in July 1911, were recovered later in the same year in the neighbouring county of Dumbarton, one on 11 September and the other on 30 December.

GUILLEMOT (*Uria troille* Linn.).

One (Case 111) marked as a chick on the Aberdeenshire coast on 11 July, 1910, was shot on 29 November of the same year twelve miles north of Gothenburg, Sweden. (Little is known of the movements of this species, which frequents the open sea from August until March.)

CORNCRAKE (*Crex crex* Linn.).

One (Case 249) was caught and marked as an adult bird in Aberdeenshire on 3 September, 1910, and was recovered in September 1911 at Naillat in the Department of Creuse, France. A second (Case 428) was marked as a chick in Cumberland on 8 July, 1912, and was recovered on 21 September of the same year at Béguey-sur-Garonne, France.

MOORHEN (*Gallinula chloropus* Linn.).

One (Case 837) marked as a chick in Aberdeenshire on 4 June, 1911, was found dead in Lancashire on 21 February, 1917. A second (Case 429), also marked in Aberdeenshire, was recovered at the place of marking a year later.

RED GROUSE (*Lagopus scoticus* Latham).

Three imported birds turned down in Inverness-shire on 21 October, 1911, were recovered near the place of marking after intervals of seven, ten, and twenty-three months, respectively. Four marked as chicks near Crieff, Perthshire, in 1913, were shot in the same district, two in the autumn of 1914 and two in the autumn of 1915 : of the former both had wandered a few miles, and of the latter one

(Case 432) was recovered about fifteen miles distant in a north-easterly direction (Glenlyon). Three others marked as chicks in Scotland were shot in their first season near the place where they were marked. One (Case 857) marked as a chick at Benarty Hill, Fifeshire, on 31 May, 1913, was caught in snares at Forgandenny, Perthshire, on 6 August, 1915, a distance of fourteen miles.

PARTRIDGE (*Perdix perdix* Linn.).

Fifteen marked in Scotland, all as hand-reared or imported birds, were recovered at the places where they were marked. Of these, twelve records can be grouped as follows :—

Birds imported from Hungary and turned down in Perthshire on 14 or 15 February, 1913: recovered on 12.9.13 and 18.9.13 (two), and about 13.10.13 (two), 13.11.13, 31.1.14, and 28.12.16 respectively.

Birds imported from Bohemia and turned down in Aberdeenshire on 30 November, 1910: recovered during the same winter, in April 1911, on 28.9.11, and on 14.10.13 respectively.

OTHER RECORDS.

There are also records for the following species :—Jackdaw and Pheasant, three each ; Yellowhammer and Wren, two each ; Bullfinch, Coal-Titmouse, Redwing, Willow-Warbler, Long-eared Owl, Cormorant, and Coot, one each. Little or no interest attaches to any of these cases.

XI.—CONCLUSIONS REGARDING BIRD-MIGRATION.

Specific Conclusions.—A number of conclusions have been reached affecting the status of various species as migrants in the British area. These have already been expressed in the preceding sections, and any detailed recapitulation would be superfluous.

Return of Migrants to the same Summer-Quarters.—The Swallow, the Spotted Flycatcher, and the Swift have afforded definite instances of this fact, previously shown in certain other cases and for long presumed on general grounds. Other records of birds recovered at the places of marking in subsequent summers are invalidated by lack of grounds for

the assumption that the individuals had left the respective localities in the interval. There are two instances of Mallard being found in a totally different area in subsequent summers, but as all the other evidence points to the native birds of that species being sedentary, the explanation of these as exceptional cases, already suggested, seems to be justified.

Return of Migrants to the same Winter-Quarters.—The only definite evidence on this point rests on a single record and refers to the Herring-Gull, a species which can scarcely be regarded as a typical migrant.

Winter-Quarters of Native British Birds.—The records for a number of the species dealt with indicate, at least in part, the winter-quarters of individuals which are summer visitors either to the British Isles as a whole or to particular districts therein. The small chances of obtaining records from, say, northern Africa make it impossible to regard these indications as exhaustive.

Summer-Quarters of Winter Visitors to the British Isles.—The only very definite evidence under this heading refers to the Starling (*q. v.*).

Part taken in Movements by Native British Birds.—As has already been repeatedly pointed out, it is typical of migration in the British area, which is a "half-way house" in Temperate Europe, that species should be present throughout the year, although known in autumn both as immigrants from the north and east and as emigrants to the south, and *vice versa* in spring. Some light has been thrown on the part played in these movements by the native British birds of several species. More evidence is still required, but in the cases of the Mallard and the Starling there is already a strong presumption that the native birds are sedentary and that any southward emigration which is observable must therefore be on the part of birds that have already come from more northerly or easterly summer areas. In other cases, such as those of the Lapwing and the Woodcock, the participation of the native birds is clearly proved. The theoretical interest of the point has already been discussed in the introduction.

"*Individual Migration.*"—This term is used to express the fact that individual birds belonging to the same species and native to the same area may behave differently as regards migration. The point has been very clearly brought out by the marking method, and in the preceding sections numerous instances are given where individuals have sought different winter-quarters, or where some individuals have remained sedentary, while others have migrated. In the case of Lapwings bred in Aberdeenshire and the neighbouring counties, for example, some have wintered there, some in Ireland, and some in Portugal. Theoretically, the question seems to present two alternatives. If all the birds are naturally endowed with a similar instinct, what is it that stimulates this to greater activity in some cases than in others where the general conditions are apparently the same? And if different instincts, or degrees of instinct, are inherited, how may this be accounted for—are there different *gentes* not morphologically distinguishable, but differing in constitution and temperament in ways not at present definable, as, for instance, a sedentary *gens*, an Ireland-seeking *gens*, and a Portugal-seeking *gens*? (Or, as a very unpromising alternative, must we re-examine the apparently overwhelming evidence in favour of migration being an inborn-habit rather than a direct effect of immediate stimuli?)

Types of Migration.—An interesting point has been brought out in the case of several species, namely, the absence of records of marked birds from what may be called "intermediate distances," a bird being usually recorded either from its native locality or from a comparatively great distance. In these cases it accordingly seems probable that individual birds are either quite sedentary or very definitely migratory, gradations being absent. In other instances, such as that of the Herring-Gull, the records clearly reveal a rather indefinite wandering tendency.

Sedentary Birds.—Some interest attaches to the evidence of the extreme nature of the sedentary habit of many individual birds, these being often recorded time after time, over a period of years, from the very same gardens.

XII.—CONCLUSIONS REGARDING THE VALUE OF THE METHOD OF BIRD-MARKING.

It is thought that the results and conclusions set forth in the preceding sections, together with the data collected by other workers, will be considered sufficient proof of the value of the marking method as a means of obtaining a certain type of fact regarding the problems of bird-migration. At the same time it will be evident that the labour involved is very great and that the percentage of marked birds recovered is generally very small, while the results are in some cases largely invalidated by inherent defects which the method displays under certain circumstances. Various reservations must accordingly now be made in appraising the method, and the conclusion that must be drawn is that it would be advisable to restrict its further practice to those lines which have been shown to be comparatively fruitful in reliable and interesting results.

The continuance of promiscuous marking is likely, of course, to yield a small proportion of isolated results that will possess an undoubted interest. But it is questionable whether records of this kind will ever adequately repay the time, labour, and money expended on the actual task of marking. Certainly these records will not equal in value the results which can be obtained by more systematic study on restricted and carefully selected lines.

It has been stated in the introduction that three qualities were considered essential, on *à priori* grounds, before a species could be regarded as a suitable subject for this kind of study: it must be available for marking in large numbers, it must afford a good percentage of reappearance records, and its migratory movements must present features worthy of investigation. To these may now be added a fourth point, namely that the circumstances must be such as will not tend to invalidate the results by the introduction of too many uncertain elements.

Quantitative as well as qualitative analysis must be aimed at in spite of the obstacles that seem to lie in the way. As has

already been pointed out, the number of birds in a given area at a particular time is only imperfectly represented by the mortality rate, because the latter varies with time of year and other circumstances. Moreover, the true mortality rate is still less adequately represented by the "recorded mortality" rate which forms the *datum* of the method. These difficulties cannot be altogether overcome, but they will be minimised where the problem takes the form of comparisons between sets of results collected under approximately similar circumstances. There is virtue, too, in the mere numbers of records, and concentration of effort should lead to an increase in these for the particular species selected. Where the total numbers are small the quantitative errors due to mere chance will obviously be great, and the extent of the possible discrepancies from this source is strikingly shown by the figures for the Lapwing (*cf.* Table II. p. 485), one of the best subjects for study.

The selection of suitable species does not exhaust the question, for it is also important that the reappearance records should fall into groups which are homogeneous as regards the circumstances of marking. A concentration of effort on particular areas would therefore have its advantages. The question of season is probably still more important, and a serious objection must be considered in the case of most marking of birds at other times than the breeding season, namely, that the birds marked may consist of a mixture of sedentary natives and visiting immigrants from other summer-quarters.

There are various other points that need not be laboured. The unreliability of isolated records which may well be abnormal will, for instance, be sufficiently obvious. The danger of laying stress on negative evidence except in very clear cases may also be mentioned: in considering the Hedge-Sparrow and the Blue Titmouse, for instance, it has been seen that almost negligible numbers of marked birds of these species are recovered where no special efforts are made, whereas an exceedingly high figure may result if continuous trapping be carried out. The absence of records from a

particular area is accordingly significant only when it can be shown that the species tends to yield a good proportion of records under circumstances such as are prevalent there.

It is therefore thought probable that promiscuous marking has now had a sufficient trial in the British Isles and that it will be found, more especially when summarised results of the "British Birds" scheme have also been published, that the necessary data are now available for the formulation of more definite plans of campaign for concentrated action. If possible, definite problems should be kept in view and the work of marking should be systematically directed to the accumulation of relevant facts. The Lapwing, to give a single instance, would assuredly yield results of the highest theoretical interest if it could be marked simultaneously and in a large number of selected districts—say, the north of Scotland, the south of England, Ireland, Holland, a district of France, and a district of Norway.

XIII.—REFERENCES.

(*References not relating to the marking method are given in the text.*)

(1) Baldwin, S. Prentiss (1919).—"Bird-Banding by Means of Systematic Trapping." (*Abs. Proc. Linn. Soc. New York*, xxv., 23.)

(2) Bartsch, Paul (1904).—"Notes on the Herons of the District of Columbia." (*Smiths. Miscel. Coll.*, xlv., 104.)

(3) Cole, Leon J. (1902).—"Suggestions for a Method of Studying the Migrations of Birds." (*Third Report of the Michigan Academy of Science*, 67.)

(4) —— (1909).—"The Tagging of Wild Birds as a Means of Studying their Movements." (*Auk*, xxvi., 137.)

(5) —— (1910).—"The Tagging of Wild Birds: Report of Progress in 1909." (*Auk*, xxvii., 154.)

(6) Douglas, S. R. (1917).—"An Experimental Investigation of the Migration of Woodcock breeding in the West of Ireland." (*Proc. Zool. Soc. London*, 1917, 159.)

(7) Hamilton, John (1908).—(*Field*, 1908, 717 & 745.)

(8) Herman, Otto, and Schenk, Jakob (1909 *et seq.*).—(*Aquila*, 1909, 34): and subsequent periodical reports.

(9) Mortensen, H. Chr. C. (1907).—"Ringfugle." (*Dansk Ornith. Forenings Tidsskrift*, i., 144.)

(10) —— (1909).—"Teal in Winter." (*Vidensk. Medd. fra den Naturhist. Forening i Köbenhavn*, 1908, 127.)

(11) —— (1911).—"Meddelelse om Nogle Ringfugle." (*Dansk Ornith. Forenings Tidsskrift*, v., 115.)

(12) —— (1912).—"Fra Fuglemærkestationen i Viborg." (*Dansk Ornith. Forenings Tidsskrift*, vi., 98.)

(13) —— (1920).—"Mærkede Storke." (*Dansk Ornith. Forenings Tidsskrift*, xiv., 91.)

(14) Percy, Lord William (1909).—(*Country Life*, 1909, 323.)

(15) Schenk, Jakob (1910).—"Das Experiment in der Vogelzugsforschung." (*Bericht über den V. Internationalen Ornithologen-Kongress*, 175): and see Herman.

(16) Thienemann, J. (1904 *et seq.*).—"Jahresberichte der Vogelwarte Rossitten." (Published annually in *Journal für Ornithologie*.)

(17) —— (1910).—"Der Zug des Weissen Storches." (*Zool. Jahrb.*, Suppl. xii., 665.)

(18) Thomson, A. Landsborough (1909).—"The Possibilities of Bird-Marking." (*Proc. Roy. Phys. Soc. Edin.*, xviii., 204.)

(19) —— (1912).—"Aberdeen University Bird-Migration Inquiry: First Interim Report (1909–12)." (*Scot. Nat.*, 1912, 144, and 1913, 29.)

(20) —— (1915).—"Aberdeen University Bird-Migration Inquiry: Second Interim Report (1912–14)." (*Scot. Nat.*, 1915, 313.)

(21) Ticehurst, Claud B. (1908).—(*British Birds Mag.*, ii., 35.)

(22) Tomlinson, Richard (*per* J. A. Harvie-Brown) (1907).—(*Annals Scot. Nat. Hist.*, 1907, 114.)

(23) Van Oort, E. D. (1911 *et seq.*).—"Bird Marking in the Netherlands." (*Notes from the Leyden Museum*, xxxiv., 55): and subsequent periodical reports.

(24) Weigold, Hugo (1910).—"Die Vogelwarte Helgoland einst und jetzt und die Methoden der Vogelzugsforschung." (*Bericht über den V. Internationalen Ornithologen-Kongress*, 563.)

(25) —— (1910 *et seq.*).—"Jahresberichte über den Vogelzug auf Helgoland." (Published annually in *Journal für Ornithologie*.)

(26) Witherby, H. F. (1909 *et seq.*).—(*British Birds Mag.*, iii. *et seq.*, *passim*.)